Abstract

Improving automated catch documentation using continuous active learning technique

Remote electronic monitoring (REM) is a video-based monitoring system onboard commercial fishing vessels that allow for continuous catch monitoring substituting or complementing observers on board the vessels. The data collected by REM systems is essential for fisheries management and sustainable exploitation of the aquatic natural resources as it contains the information about the catch composition and quantity and therefore allows estimating fishing mortality and bycatch fraction with higher precision. REM systems embedded at the conveyor belt of the fishing vessel enable complete catch recording every time the vessel is out fishing. REM systems consequently provide a vast amount of video data of which full analysis is infeasible to perform by human review. In particular, demersal trawl fisheries are challenged by the mixed nature of catch composition, including high catch rates of unmarketable and undersized fish, which creates an extra challenge for accurate catch identification in this fishery. In recent years, powerful data-driven deep learning techniques have been developed that allow effective processing of visual data. Like in many other applications, these techniques have been successfully applied for catch registration. However since these methods are dependent on the training data, their inference performance tends to decrease when a deviating new dataset is encountered. This happens frequently in demersal trawl fisheries, as there can be a vast amount of variation in catch composition between hauls and consequently the appearance of the fishes. Transfer learning and fine tuning allow to overcome this limitation, but this involves the preparation of new training data, which is time-consuming and may be inefficient when the wrong training samples are selected.

Continuous active learning technique aims to automatically select the most valuable new training examples to be annotated and added to the training set followed by the transfer learning of the previously trained model. In this study, we propose BoxAL, a continuous active learning technique that estimates the uncertainty of the predictions of Faster Region-based CNN to select the most informative images, which are then used to retrain the model. To evaluate the method, we used image data obtained with a REM system developed for commercial trawlers targeting demersal species. The images were collected from different trips in the North Sea, containing a high level of catch composition diversity between the hauls. We tested the hypothesis that continuous active learning improves the accuracy and efficiency of automated catch registration in the conditions of high target objects' variation.

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